Instructions to candidates (Please Read Carefully):

(1) **Time allowed:** Reading - 15 minutes. Writing - 03 hours.

(2) **All questions should be answered.**

(3) **Answers** should be in **one language**, in the **medium** applied for, in the **booklets** provided.

(4) Submit all workings and calculations. State clearly assumptions made by you, if any.

(5) **Use of Non-programmable calculators is only permitted.**

(6) **Mathematical Tables** will be provided.

(7) **Action Verb Check List** with definitions is attached. Each question will begin with an **action verb** excluding OTQ’s. Candidates should answer the questions based on the **definition** of the verb given in the Action Verb Check List.

(8) **Formulae Sheets** are attached.

(9) 100 Marks.

SECTION A

Objective Test Questions (OTQs)

Fifteen (15) compulsory questions

(Total 40 marks)

Question 01

Select the most correct answer for question No. 1.1 to 1.10. Write the number of the selected answer in your answer booklet with the number assigned to the question.

1.1 If \(5x + 7 = 23 + x\), the value of \(x\) is:

(1) 5   (2) 4   (3) 3   (4) 7  (03 marks)

1.2 Manoj obtained a mortgage loan of Rs.100,000/- from a bank at the interest rate of 18% per annum and repayable in 4 equal annual instalments at the end of every year. The value of the instalment to be paid per annum for the loan would be **(to the nearest integer)**:

(1) Rs.43,000/-  (2) Rs.43,428/-  (3) Rs.31,978/-  (4) Rs.37,174/-  (03 marks)
1.3 If the monthly Total Revenue Function of a new product is given by \( TR = 4,500 + 30q – 3q^2 \), the Marginal Revenue Function (MR) of that product would be:

(1) \( 30 – 6q \)  
(2) \( 30q – 6q^2 \)  
(3) \( 4,500 + 30q – 6q^2 \)  
(4) \( 4,500 – 6q^2 \)  
(03 marks)

1.4 Kasun deposited Rs.150,000/- in a bank for 5 years at a simple interest rate of 12.25% per annum. The total interest earned by him for 5 years would be:

(1) Rs.98,175/-  
(2) Rs.91,875/-  
(3) Rs.58,125/-  
(4) Rs.18,375/-  
(03 marks)

1.5 The marks obtained by a student for his seven assignments were as follows:

50, 52, 54, 56, 58, 60, \( x \)

If the mean of the marks obtained by him for the assignments is 56, the value of “\( x \)” would be:

(1) 57  
(2) 62  
(3) 64  
(4) 68  
(03 marks)

1.6 The number of hours spent (\( x \)) for studying for an examination by 12 students, together with the marks obtained (\( y \)) by them in the particular examination, are summarized below:

\[
\begin{align*}
\sum x &= 76 & \sum x^2 &= 560 & \sum y &= 913 & \sum y^2 &= 75,153 & \sum xy &= 6,425 & n &= 12
\end{align*}
\]

Based on the above data, the correlation coefficient between \( x \) and \( y \) is:

(1) \(-0.96\)  
(2) \(0.96\)  
(3) \(-0.69\)  
(4) \(0.69\)  
(03 marks)

1.7 The following table shows the prices of three items \( P \), \( Q \) and \( R \) for the year 2015 and 2017:

<table>
<thead>
<tr>
<th>Item</th>
<th>Price per kg (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015</td>
</tr>
<tr>
<td>( P )</td>
<td>200</td>
</tr>
<tr>
<td>( Q )</td>
<td>160</td>
</tr>
<tr>
<td>( R )</td>
<td>540</td>
</tr>
</tbody>
</table>

Based on the above data, the simple aggregate price index for the year 2017, considering the year 2015 as the base year, would be (to the nearest integer):

(1) 123%  
(2) 120%  
(3) 118%  
(4) 111%  
(03 marks)
1.8 The price of a share \((x)\) of a particular company on any given day is known to vary according to the following probability \((p)\) distribution:

<table>
<thead>
<tr>
<th>Price of share, Rs. ((x))</th>
<th>60.00</th>
<th>62.50</th>
<th>65.00</th>
<th>67.50</th>
<th>80.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability ((p))</td>
<td>0.05</td>
<td>0.2</td>
<td>0.1</td>
<td>(\ldots a \ldots)</td>
<td>0.4</td>
</tr>
</tbody>
</table>

The value of ‘\(a\)’ would be:

\[
\begin{align*}
(1) & \quad 0.55 \\
(2) & \quad 0.25 \\
(3) & \quad 0.025 \\
(4) & \quad 0.0025 \\
\end{align*}
\]

(03 marks)

1.9 The following table summarizes the results of an interview conducted by a reputed company to recruit Management Trainees for the year 2019:

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>18</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>Fail</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>62</td>
<td>100</td>
</tr>
</tbody>
</table>

The probability that the chosen candidate who passes the interview, if he is a male would be (approximately):

\[
\begin{align*}
(1) & \quad 0.27 \\
(2) & \quad 0.35 \\
(3) & \quad 0.47 \\
(4) & \quad 0.51 \\
\end{align*}
\]

(03 marks)

1.10 The value of the common difference of the arithmetic sequence generated by \(T_n = 18 - 5n\) would be:

\[
\begin{align*}
(1) & \quad 13 \\
(2) & \quad 5 \\
(3) & \quad -8 \\
(4) & \quad -5 \\
\end{align*}
\]

(03 marks)

Write the answers for question No. 1.11 to 1.13 in your answer booklet with the number assigned to the question.

1.11 **PQR Company** is in the process of evaluating projects to select the best project from 3 different projects A, B and C using the Net Present Value (NPV) and the computed NPV of each project is as follows:

<table>
<thead>
<tr>
<th>Project</th>
<th>NPV (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>98,000</td>
</tr>
<tr>
<td>B</td>
<td>90,000</td>
</tr>
<tr>
<td>C</td>
<td>(99,500)</td>
</tr>
</tbody>
</table>

Identify the best project with justification for selection. (02 marks)
1.12 Rs.850,000/- was divided among A, B, and C. A’s share was Rs.10,000/- less than that of B’s share and C’s share was twice of A’s share.

Calculate the share of C. \( \text{(02 marks)} \)

1.13 The value of the correlation coefficient, \( r \) is 0.95 for the relationship between advertising expenditure and sales income shown in the scatter diagram plotted below:

Identify the relationship between advertising expenses and sales income. \( \text{(02 marks)} \)

State whether each of the following statements is True or False. Write the answer (True/False) in your answer booklet with the number assigned to the question.

1.14 Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. \( \text{(02 marks)} \)

1.15 Two events which can happen simultaneously on a single trial are called as mutually exclusive events. \( \text{(02 marks)} \)

(Total 40 marks)

End of Section A
SECTION B

Four (04) compulsory questions
(Total 40 marks)

**Question 02**

(a) A person deposited Rs.225,000/- in a savings account of a bank for 2 years, at the simple interest rate of 14% per annum.

You are required to:

Calculate the total amount in his account at the end of 2 years. (03 marks)

(b) Perera intends to purchase an air conditioner from ABC Ltd. and the company agrees to sell it paying Rs.500,000/- in cash immediately and the balance amount of Rs.200,000/- is repayable in equal two annual instalments with an interest rate of 8% per annum.

You are required to:

(i) Calculate the total amount to be paid by Perera to ABC Ltd. at the end of 2 years for the purchase of the air conditioner if interest is compounded annually. (03 marks)

(ii) Calculate the amount being paid to ABC Ltd. as the interest at the end of 2 years if the interest is compounded quarterly. (04 marks)

(Total 10 marks)

**Question 03**

(a) You are given the following Total Revenue (TR) Function and Total Cost (TC) Function:

\[ TR = 700q \]

\[ TC = 12,500 + 450q \]

where ‘q’ is the number of units.

You are required to:

(i) Identify the profit function. (03 marks)

(ii) Calculate the break-even quantity. (03 marks)

(b) The total profit function for a commodity is given by:

\[ P(x) = -2x^2 + 100x + 600 \]

Where \( x \) is the number of units sold.

You are required to:

Calculate the number of units at which the profit is maximized. (04 marks)

(Total 10 marks)
Question 04

The management of **MCSL Restaurant** wanted to identify the waiting time taken to process each food order. Accordingly, they have recorded the waiting time for 50 food orders that were placed with them last Saturday night and tabulated below:

<table>
<thead>
<tr>
<th>Minutes</th>
<th>No. of orders (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 – 03</td>
<td>06</td>
</tr>
<tr>
<td>04 – 06</td>
<td>11</td>
</tr>
<tr>
<td>07 – 09</td>
<td>12</td>
</tr>
<tr>
<td>10 – 12</td>
<td>13</td>
</tr>
<tr>
<td>13 – 15</td>
<td>8</td>
</tr>
</tbody>
</table>

You are required to:

Calculate the following:

(a) Mean. (04 marks)

(b) Standard Deviation. (04 marks)

(c) Coefficient of variation of the waiting time. (02 marks)

(Total 10 marks)

Question 05

The following table shows the retail selling prices of electrical items \(x\) and the volume of sales \(y\) at different prices of an electrical goods warehouse:

<table>
<thead>
<tr>
<th>Selling Price (x) (Rs.)</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>220</th>
<th>240</th>
<th>260</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Volume (y) (in thousands)</td>
<td>400</td>
<td>300</td>
<td>275</td>
<td>250</td>
<td>210</td>
<td>190</td>
<td>150</td>
<td>100</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>

\[
\sum x = 1,580 \quad \sum y = 1,925 \quad \sum xy = 229,300 \quad \sum x^2 = 293,200 \quad \sum y^2 = 503,325
\]

(a) Identify the least square regression line given by \(y = a + bx\) to determine the linear relationship between the above two variables: (07 marks)

(b) Calculate the expected sales volume of the item, if the selling price is Rs.150/-: (03 marks)

(Total 10 marks)

End of Section B
(A) The following table presents the quarterly sales, 4 quarter moving average and centered moving average figures of a software product. Assume a multiplicative model in which there are no cyclical and random variations, \((R = 1, \ C = 1)\):

<table>
<thead>
<tr>
<th>Year</th>
<th>Quarter</th>
<th>t</th>
<th>Y</th>
<th>4 Quarter Moving Average</th>
<th>Centered Moving Average (T)</th>
<th>Y/T</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>1</td>
<td>1</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>150</td>
<td>137.5</td>
<td>140</td>
<td>1.071</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
<td>145</td>
<td></td>
<td>140.625</td>
<td>1.031</td>
</tr>
<tr>
<td>2016</td>
<td>5</td>
<td>5</td>
<td>140</td>
<td></td>
<td>132.5</td>
<td>1.057</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>6</td>
<td>120</td>
<td></td>
<td>121.875</td>
<td>0.985</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>7</td>
<td>100</td>
<td>117.5</td>
<td>115</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>8</td>
<td>110</td>
<td></td>
<td>115</td>
<td>0.957</td>
</tr>
<tr>
<td>2017</td>
<td>9</td>
<td>9</td>
<td>120</td>
<td></td>
<td>( _ _ _ (d) _ _ _ )</td>
<td>0.932</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>140</td>
<td></td>
<td>( _ _ _ (e) _ _ _ )</td>
<td>0.957</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>11</td>
<td>190</td>
<td></td>
<td>( _ _ _ (c) _ _ _ )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>12</td>
<td>160</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
You are required to:

(a) **Identify** the respective values for (a) to (e) of the above table.  

(b) **Compute** the seasonal index corresponding to the third quarter to fill the below table which shows the quarterly seasonal indices computed for the above data:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Seasonal Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>0.9945</td>
</tr>
<tr>
<td>Q2</td>
<td>0.971</td>
</tr>
<tr>
<td>Q3</td>
<td>0.994</td>
</tr>
<tr>
<td>Q4</td>
<td>0.994</td>
</tr>
</tbody>
</table>

(B) The probability that a worker comes to work by Train, Bus, Motor Bicycle to his office are 3/10, 3/5, 1/10 respectively. The probability that he will be late to office if he comes by Train, Bus, Motor Bicycle are 1/4, 1/3 and 1/12 respectively:

You are required to:

(a) **Draw** a tree diagram to represent the above information.  
(b) **Calculate** the probability that the worker comes to work on time.

(C) It was observed that 80% of the students passed in mathematics paper, 60% of students passed in science paper and 40% of students passed in both these subjects in a monthly examination.

You are required to:

**Calculate** the probability of a student passing the mathematics paper if he passed the science paper.
## ACTION VERB CHECK LIST

<table>
<thead>
<tr>
<th>Knowledge Process</th>
<th>Verb List</th>
<th>Verb Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 01</strong></td>
<td>Define</td>
<td>Describe exactly the nature, scope, or meaning.</td>
</tr>
<tr>
<td><strong>Comprehension</strong></td>
<td>Draw</td>
<td>Produce (a picture or diagram).</td>
</tr>
<tr>
<td></td>
<td>Identify</td>
<td>Recognize, establish or select after consideration.</td>
</tr>
<tr>
<td></td>
<td>List</td>
<td>Write the connected items one below the other.</td>
</tr>
<tr>
<td></td>
<td>Relate</td>
<td>To establish logical or causal connections.</td>
</tr>
<tr>
<td></td>
<td>State</td>
<td>Express something definitely or clearly.</td>
</tr>
<tr>
<td></td>
<td>Calculate/Compute</td>
<td>Make a mathematical computation</td>
</tr>
<tr>
<td></td>
<td>Discuss</td>
<td>Examine in detail by argument showing different aspects, for the purpose of arriving at a conclusion.</td>
</tr>
<tr>
<td></td>
<td>Explain</td>
<td>Make a clear description in detail revealing relevant facts.</td>
</tr>
<tr>
<td></td>
<td>Interpret</td>
<td>Present in an understandable terms.</td>
</tr>
<tr>
<td></td>
<td>Recognize</td>
<td>To show validity or otherwise, using knowledge or contextual experience.</td>
</tr>
<tr>
<td></td>
<td>Record</td>
<td>Enter relevant entries in detail.</td>
</tr>
<tr>
<td></td>
<td>Summarize</td>
<td>Give a brief statement of the main points (in facts or figures).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge Process</th>
<th>Verb List</th>
<th>Verb Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 02</strong></td>
<td>Apply</td>
<td>Put to practical use.</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Assess</td>
<td>Determine the value, nature, ability, or quality.</td>
</tr>
<tr>
<td></td>
<td>Demonstrate</td>
<td>Prove, especially with examples.</td>
</tr>
<tr>
<td></td>
<td>Graph</td>
<td>Represent by means of a graph.</td>
</tr>
<tr>
<td></td>
<td>Prepare</td>
<td>Make ready for a particular purpose.</td>
</tr>
<tr>
<td></td>
<td>Prioritize</td>
<td>Arrange or do in order of importance.</td>
</tr>
<tr>
<td></td>
<td>Reconcile</td>
<td>Make consistent with another.</td>
</tr>
<tr>
<td></td>
<td>Solve</td>
<td>To find a solution through calculations and/or explanation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge Process</th>
<th>Verb List</th>
<th>Verb Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 03</strong></td>
<td>Analyze</td>
<td>Examine in detail in order to determine the solution or outcome.</td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td>Compare</td>
<td>Examine for the purpose of discovering similarities.</td>
</tr>
<tr>
<td></td>
<td>Contrast</td>
<td>Examine in order to show unlikeness or differences.</td>
</tr>
<tr>
<td></td>
<td>Differentiate</td>
<td>Constitute a difference that distinguishes something.</td>
</tr>
<tr>
<td></td>
<td>Outline</td>
<td>Make a summary of significant features.</td>
</tr>
</tbody>
</table>
Mathematical Fundamentals:

Quadratic equation:
The solutions of a quadratic equation, \( ax^2 + bx + c = 0 \) is given by
\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]

Arithmetic sequence:
The sum of first \( n \) terms of an AP:
\[
S = \frac{n}{2} \left( 2a + (n - 1)d \right)
\]

Geometric sequence:
The sum of first \( n \) terms of a GP:
\[
S = a \left( \frac{r^n - 1}{r - 1} \right) \quad \text{if} \quad r > 1
\]
\[
S = a \left( \frac{1 - r^n}{1 - r} \right) \quad \text{if} \quad r < 1
\]
\[
S = na \quad \text{Otherwise} \quad r = 1
\]

Quantitative Finance:

Simple interest:
\( S = X (1 + nr) \)

Compound Interest:
\( S = X \{1 + r\}^n \)

Discounting:
Present Value = Future Value \( \times \frac{1}{(1+r)^n} \)

Repayment of mortgage:
\[
A = \frac{SR^n(R - 1)}{R^n - 1}
\]

Internal Rate of Return:
\[
IRR = \frac{[N_t r_2 - N_t r_1]}{[N_t - N_t]} \quad \% 
\]
Or
\[
IRR = a\% + \frac{NPV_A}{NPV_A - NPV_B} (b - a)\%
\]

Numerical Descriptive Measures:

Mean \( \bar{x} \):
For ungrouped data: \( \frac{\sum x}{n} \)
For grouped data: \( \frac{\sum fx}{\sum f} \)

Standard deviation \( \sigma \):
For ungrouped data:
\[
\sqrt{\frac{\sum(x - \bar{x})^2}{n}} \quad \text{or} \quad \sqrt{\frac{\sum x^2 - \bar{x}^2}{n}}
\]
For grouped data:
\[
\sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \quad \text{or} \quad \sqrt{\frac{\sum f x^2 - \bar{x}^2}{\sum f}}
\]

Coefficient of variation (CV):
\[
\frac{\text{Standard deviation}}{\text{Mean}} = \frac{\sigma}{\bar{x}} \times 100
\]

Comparing Two Quantitative Variables:

Pearson's Product Moment Correlation.

Correlation coefficient \( r \):
\[
\frac{[n \sum xy - \sum x \sum y]}{\sqrt{[n \sum x^2 - (\sum x)^2] \times [n \sum y^2 - (\sum y)^2]}}
\]

Regression coefficients \( a \) and \( b \):
\[
b = \frac{[n \sum xy - \sum x \sum y]}{[n \sum x^2 - (\sum x)^2]}
\]
\[
a = \bar{y} - b\bar{x}
\]
Comparison over time with Economic variables

Index Numbers:

- Price Relative \(= \frac{p_1}{p_0} \times 100\)
- Quantity Relative \(= \frac{q_1}{q_0} \times 100\)
- Value Relative \(= \frac{v_1}{v_0} \times 100\)

Simple aggregate price index \(= \frac{\sum p_1}{\sum p_0} \times 100\)

Simple aggregate quantity index \(= \frac{\sum q_1}{\sum q_0} \times 100\)

Average price relative \(= \frac{1}{n} \sum \frac{p_1}{p_0} \times 100\)

Average quantity relative \(= \frac{1}{n} \sum \frac{q_1}{q_0} \times 100\)

Weighted aggregate indices

1) Base-weighted / Laspeyre’s:
   - Price index \(= \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100\)
   - Quantity index \(= \frac{\sum q_1 p_0}{\sum q_0 p_0} \times 100\)

2) Current-weighted / Paasche’s:
   - Price index \(= \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100\)
   - Quantity index \(= \frac{\sum q_1 p_1}{\sum q_0 p_1} \times 100\)

3) Using standard weights
   - Price index \(= \frac{\sum p_1 w}{\sum p_0 w} \times 100\)
   - Quantity index \(= \frac{\sum q_1 w}{\sum q_0 w} \times 100\)

Weighted average of relatives

- Price index \(= \frac{\sum [w \times I_p]}{\sum w} \times 100\)
- Quantity index \(= \frac{\sum [w \times I_q]}{\sum w} \times 100\)

Time Series:

Additive model
\(Y = T + S + C + R\)

Multiplicative Model
\(Y = T \times S \times C \times R\)

Sets and Probability

- Union; \(A \cup B\) defines all elements in \(A\) plus all elements in \(B\), no element being counted twice.

- Intersection; \(A \cap B\) defines all elements included in both \(A\) and \(B\).

\(P(A)\) – Probability of event \(A\)
\(P(A/B)\) – Probability of event \(A\), given \(B\)

General rules:
\(P(A \cup B) = P(A) + P(B) - P(A \cap B)\)
\(P(A/B) = \frac{P(A \cap B)}{P(B)}\)

Expectation and Variance of a discrete random variable:
\(E(X) = \sum\text{(probability} \times \text{payoff}) = \sum p \times x\)
\(VAR(X) = \sum px^2 - (\sum px)^2\)

Normal Distribution:
\(Z = \frac{x - \mu}{\sigma}\)